PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
et al.

Art Unit: Unknown

Examiner: Unknown

Serial No. Unknown

Docket No. TER-002.3P D4

Filed: 1/12/01

For: **APPARATUS AND METHOD FOR SCDMA DIGITAL DATA TRANSMISSION USING ORTHOGONAL CODES AND A HEAD END MODEM WITH NO TRACKING LOOPS**

- -

Honorable Commissioner
of Patents and Trademarks
Washington, D.C. 20231

Morgan Hill, California
January 12, 2001

PRELIMINARY AMENDMENT

Dear Sir:

Please amend the above identified case as follows.

IN THE DRAWINGS

Enclosed are markups of Figures 53B and 53C to conform these figures to the description of the process given in Figure 60 and the specification changes described below with the changes marked in red. Also enclosed is a markup of Figure 60 with changes marked in red to eliminate duplicate reference numbers.

IN THE SPECIFICATION

At page 1, line 1, please delete the title and insert the following new title --

APPARATUS AND METHOD FOR TRELLIS ENCODING DATA FOR TRANSMISSION IN DIGITAL DATA TRANSMISSION SYSTEMS--

At page 143, line 26, after ".", insert --When the RU sends training data, it sets tap coefficients of its precode equalization filter such as filter 563 in Figure 33 to values that cause the precode equalization filter to not predistort the training data signal.--

At page 144, line 8, delete the sentence "The RU then sets these final tap weight coefficients into FFE and DFE equalizers within the precode equalizatin filter 563 in the transmitter of Figure 33, as symbolized by step 1124." and substitute, --To calculate the new coefficients for the precode equalization filter 563 in the RU transmitter of Figure 33, the old coefficients of the RU precode filter FFE and DFE equalization filter are convolved with the new coefficients FFE and DFE coefficients which the central unit modem symbol equalizer circuit converged on to derive new coefficients. These new coefficients are then set into the RU precode filter.--

At page 144, line 17, delete "tap weight coefficients of FFE and DFE" and substitute --the main tap of said FFE equalizer 921 in Figure 50 to one and sets the side tap coefficients of the FFE equalization filter 921 and the DFE equalization filter 929 in Figure 50 to zero --. At line 18, delete "equalizers 765 and 820, respectively to one".

At page 145, lines 10 through 13, delete the sentence "After convergence, the RU CPU reads the final tap weight coefficients for the FFE equalizer 765 and the DFE equalizer 820 via bus 833 and, in this alternative embodiment, sends these tap weight coefficients to the FFE/DFE circuit 764 in the RU receiver of Figure 30 via bus 822, as symbolized by step 1132." and substitute the following --After convergence, the RU CPU reads the final tap weight coefficients for the FFE equalizer 765 and the DFE equalizer 820 via bus 833 and calculates new tap weight coefficients for the FFE and DFE filters of the CE circuit 764 in the RU receiver of Figure 30 by convolving the old

CE filter tap weights with the FFE and DFE filter tap coefficients converged upon by the SE circuit during reception of multiple bursts of training data, and loads these newly calculated tap weight coefficients into the FFE and DFE filters of CE circuit 764 in the RU receiver of Figure 30 via bus 844, as symbolized by step 1132 of Figure 53C.--.

At page 169, line 17, delete "1502" and subsitute --1501--.

At page 169, line 21, delete "1504" and subsitute --1507--.

At page 169, line 29, delete "1506" and subsitute --1509--.

At page 169, line 31, delete "1508" and subsitute --1511--.

At page 170, line 2, delete "1510" and subsitute --1513--.

At page 170, line 10, delete "1512" and subsitute --1515--.

At page 170, line 5, delete "1516" and subsitute --1517--.

At page 170, line 12, delete "1514" and subsitute --1519--.

At page 170, line 14, after "." and before "Then", insert --The main tap coefficient of the SE feed forward equalization filter is then set to one and the side tap coefficients of the SE feed forward and decision feedback equalization filters are set to zero for receipt of payload data.--

At page 187, delete the entire paragraph that extends from line 24 to line 27.

IN THE CLAIMS

Please cancel claims 1-83 from the parent spec and add the below claims:

1. A process carried out to achieve frame synchronization in any digital data communication system having a plurality of physically distributed remote transceivers transmitting frames of the same size on the same frequency on a shared medium to a headend transceiver, comprising the steps:

(a) iteratively transmitting a ranging signal that has correlation

properties such that it can be found in the presence of noise, and conducting a trial and error adjustment of a transmit frame timing delay value prior to each transmission of said ranging signal until receiving a message from said headend transceiver that a ranging signal has been found in a gap surrounding a reference time, said gap being an interval during upstream transmissions from said plurality of distributed remote transceivers to said headend transceiver when transmissions of anything other than ranging signals by said remote transceivers is not permitted;

(b) when said message is received by the remote transceiver that transmitted said ranging signal, holding said transmit frame timing delay at the same value it had just before receiving said message, and transmitting identifying information to said headend transceiver to identify said remote transceiver; and

(c) receiving a message from said headend transceiver directed to said remote transceiver which transmitted said identifying information indicating by how much to adjust said transmit frame timing delay such that frames transmitted from said remote transceiver will have their frame boundaries exactly or almost exactly aligned in time at the location of said headend transceiver with the frame boundaries of frames transmitted from other said remote transceivers.

2. The process of claim 1 wherein one of said gaps is between every upstream frame, and wherein said step of transmitting identifying information comprises the steps of sending a unique sequence of transmissions over an authentication interval

comprised of an even number of said gaps, said unique sequence of transmissions comprised of transmissions of said ranging signal and silent intervals when no ranging signal is transmitted during said authentication interval, the exact sequence of ranging signals and silent intervals being unique to said remote transceiver and having ranging signals sent during exactly 50% of said gaps of said authentication interval.

3. The process of claim 2 further comprising the steps performed after step (b) and before step (c) of receiving a message from said headend transceiver indicating whether a ranging signal was received in more than 50% of said gaps of said authentication interval, and, if so, performing a contention resolution algorithm comprised of a random decision to stop the ranging process or continue with it, with the probability of either outcome being 50%, and if the decision not to continue ranging is made, stopping the ranging process for an interval and not performing step (c), and then commencing ranging again with step (a) but starting with the transmit frame timing delay which existed at the time the decision to stop ranging was made.

4. A ranging process for use in a distributed system comprising a central transceiver coupled by a shared transmission media to a plurality of remote transceiver at physically disparate locations at least two of which send frames of digital data of the same size on the same frequency to said central transceiver, comprising the steps of:

adjusting a transmit frame timing delay value in each remote transceiver so as to achieve frame synchronization such that frames transmitted by each remote transceiver arrive with their frame boundaries aligned in time with the frame boundaries of frames transmitted by others of said remote transceivers

which have achieved frame synchronization by performing the following steps in each remote transceiver:

determining the propagation time in said remote transceiver from said remote transceiver to said central transceiver via said shared transmission media by iteratively transmitting a ranging signal which can be detected by said central transceiver in the presence of noise and which is transmitted by said remote transceiver in response to receipt of an invitation signal transmitted by said central transceiver, and adjusting a transmit frame timing delay value for said remote transceiver prior to each transmission of said ranging signal until a transmit frame timing delay value is reached which causes said remote transceiver to receive one or more messages from said central transceiver, and using said messages to determine when a transmit frame timing delay value has been reached that causes said ranging signal to arrive at said central transceiver during an interval that encompasses a time of arrival at said central transceiver which would cause frame synchronization to exist for said remote transceiver, and then transmitting signals that identify said remote transceiver to said central transceiver, and using said one or more messages to make proper additional adjustments to said transmit frame timing delay value so as to achieve frame synchronization with frames transmitted from all other remote transceivers which have previously successfully achieved frame synchronization;

after frame synchronization has been achieved, thereafter using

the value so fixed for said transmit frame timing delay for every transmission by said remote transceiver to said central transceiver.

5. The process of claim 4 further comprising the steps of, from time to time after frame synchronization has been achieved, performing the following training process to verify that frame synchronization still exists and make adjustments if it does not still exist, said training process comprising:

sending training data from said remote transceiver to said central transceiver, said training data having its spectrum spread by a predetermined spreading code which is one of the middle codes in a group of contiguous, orthogonal, cyclic spreading codes and is known to said central transceiver;

determining in said central transceiver if said training data was received solely on said predetermined spreading code or if some of the energy of said training data was received on any of said contiguous, orthogonal cyclic codes;

if said training data was received only on said predetermined spreading code, doing nothing;

if some or all of the energy of said training data was received on any of said contiguous, orthogonal, cyclic spreading codes, performing a fine tuning process to calculate the time offset between the actual time of arrival at said central transceiver of a transmission from said remote transceiver and the desired time of arrival which would cause frame synchronization to exist, and sending a message to said remote transceiver telling it by how much to adjust its transmit frame timing delay to achieve frame synchronization.

6. The process of claim 4 wherein said remote transceivers transmit data to said central transceiver in frames each of which includes a guardband during which no data is sent, and wherein said central transceiver sends a message to said remote transcevier when said ranging signal is received at said central transceiver during said guardband, and wherein said step of using said one or more messages to make proper additional adjustments to said transmit frame timing delay value so as to achieve frame synchronization comprises receiving a message that includes fine tuning adjustment data that indicates the distance and direction in time of the actual arrival time of said ranging signal from a predetermined desired location in said guardband which would cause frame synchronization to exist and using said fine tuning adjustment data to adjust said transmit frame timing delay to achieve precise frame synchronization.

7. The process of claim 5 wherein said remote transceivers transmit data to said central transceiver in frames each of which includes a guardband during which no data is sent, and wherein said central transceiver sends a message to said remote transceiver when said ranging signal is received at said central transceiver during said guardband, and wherein said step of using said one or more messages to make proper additional adjustments to said transmit frame timing delay value so as to achieve frame synchronization comprises receiving a message that includes fine tuning adjustment data that indicates the distance and direction in time of the actual arrival time of said ranging signal from a predetermined desired location in said guardband which would cause frame synchronization to exist and using said fine tuning adjustment data to adjust said transmit frame timing delay to achieve precise frame synchronization.

8. The process of claim 4 further comprising a power alignment process carried out in a remote transceiver comprising the steps:

setting the gain of a scaling amplifier in said remote transceiver to a predetermined initial level;

iteratively transmitting training data having its spectrum spread by a predetermined code in a group of orthogonal, cyclic spreading codes and modulated using BPSK modulation on an upstream radio frequency carrier; and

receiving a final gain correction factor from said central transceiver after said central transceiver has received said iterative transmissions of training data and an adaptive gain control circuit therein has converged on a final gain control factor that minimizes reception errors of said training data; and

setting the gain of said scaling amplifier in said remote transceiver to the value of said final gain correction factor.

9. The process of claim 4 further comprising a power alignment process carried out in said central transceiver comprising the steps:

setting the gain of an amplfier in an adaptive gain control circuit in said central transceiver to an initial gain level for said predetermined code to minimize reception errors of data spread by that code;

receiving iterative transmissions of BPSK modulated training data transmitted by a remote transceiver whose gain level is to be aligned, and making an adjustment to a gain correction factor to reduce slicer error in receiving said training data after each iteration until convergence on a final gain correction factor is achieved; and

sending the final gain correction factor downstream to said remote transceiver and setting the gain of said amplifier in the adaptive gain control circuit in said central transceiver to one.

10. The process of claim 4 further comprising an upstream equalization process carried out in said central transceiver for each remote transceiver comprising the steps:

sending a message to said remote transceiver requesting it to iteratively transmit training data to said central transceiver, said training data having its spectrum spread by one or more of a plurality of adjacent, orthogonal, cyclic spreading codes;

iteratively adapting the tap weight coefficients of FFE and DFE equalizers until final tap weight coefficients are derived which minimize reception errors of said training data; and

sending the final tap weight coefficients to said remote transceiver and setting the tap weight coefficients of said FFE and DFE equalizers in said central transceiver to values which render said FFE and DFE equalizers transparent.

11. The process of claim 4 further comprising an upstream equalization process carried out in each remote transceiver comprising the steps:

(a) receiving a message from said central transceiver requesting the transmission of training data;

(b) iteratively transmitting training data having its spectrum spread with one or more of a plurality of orthogonal, cyclic spreading codes;

(c) receiving final tap weight coefficients from said central transceiver after convergence by equalization circuitry in said central transceiver on final tap weight coefficients that minimize reception errors of said training data;

(d) convolving said final tap weight coefficients with existing equalization filter coefficients in said remote transceiver used to send said training data, and setting said equalization filter coefficients to the tap weight coefficients resulting from said convolving process; and

(e) using the new equalization filter coefficients derived in step (d) for subsequent upstream transmissions of payload data.

12. The process of claim 4 further comprising a downstream equalization process carried out in said remote transceiver, comprising the steps:

receiving iteratively transmitting training data on at least one of a plurality of adjacent, orthogonal, cyclic spreading codes transmitted by said central transceiver;

adjusting the tap weight coefficients of a first adaptive equalization circuit including a slicer after receiving each iteration of training data until convergence on final tap weight coefficients is achieved that minimizes reception errors of said training data; and

transferring said final tap weight coefficients to a second equalization circuit in said remote transceiver.

13. A ranging process to achieve frame synchronization in each of a plurality of physically distributed remote units that transmit upstream frames of data on the same

medium and the same frequency to a central unit comprising the steps:

(a) broadcasting from said central unit a barker code during every frame;

(b) in each remote unit that is attempting to achieve frame synchronization, receiving said barker code broadcast by said central unit, and iteratively transmitting the same barker code back toward said central unit during each upstream frame after setting a trial and error value for a transmit timing delay before each transmission of said barker code;

(c) monitoring a ranging interval gap using a receiver in said central unit for receipt of said barker code by performing a correlation calculation;

(d) when said central unit detects a barker code in said gap, broadcasting a message to all remote units indicating a barker code has been found in said gap and asking each remote unit that is performing said ranging process to send a signature sequence to identify itself where said signature sequence comprises sending said barker code during a predetermined number which is less than all of the frames of a multiple frame authentication interval using the same transmit timing delay used in the last transmission of a barker code before receiving the message from said central unit that a barker code had been detected in the guardband, said transmissions of said barker code and silences during said authentication interval defining a signature sequence unique to said remote unit;

(e) performing a correlation in said central unit to determine during which gaps of the gaps in said authentication interval barker codes were received, and if more than said predetermined number of barker codes were received during said authentication interval;

(f) if barker codes are found in the correct predetermined number of gaps of said

authentication interval, determining the sequence of gaps in which barker codes were found and identifying the remote unit which transmitted the signature sequence by the sequence of gaps in which barker codes were found and silences in said authentication interval and broadcasting said identity so found from said central unit;

(g) receiving said identity broadcast in the remote units which are performing said ranging process and, in each remote unit, comparing the identity broadcast to the remote unit's identity, and, if a match is found, performing a fine tuning process to exactly center a barker code transmission in a gap using one or more messages received from said central transceiver containing adjustment data so as to achieve precise frame synchronization.

REMARKS

Prior Art

Some of the claims added by this preliminary amendment which do not require ranging gaps between every frame in the upstream transmissions are similar to DOCSIS 1.0 ranging which dates back to approximately 1997 or 1998. However, the ranging disclosures of the specification date back to a parent case serial number 08/519,630 filed in 8/25/95 so the DOCSIS 1.0 modems are not believed to be prior art.

In the enclosed IDS, the "Seki: A Wireless Multimedia Network on a Time Division DuplexCDMA/TDMA" published in IEICE Transactions On Communications, Vol. E78-8, No. 7 July 1995 and U.S. patent 5,327,455 were apparently the most pertinent references to the EPO examiner in the TER-002.2P parent case EPO version on a claim set directed to an RU upstream synchronous CDMA method including a ranging step to achieve frame synchronization. The claims presented herein are directed to ranging and training processes standing alone regardless of whether the upstream

multiplexing is CDMA or TDMA. The Seki reference teaches that it is known to teach a bidirectional wireless digital data communication system with a plurality of distributed remote units that communicate with a central unit. The central unit is coupled to an ATM local area network and transmits high speed video signals to the remote units via a TDMA downstream. Each frame in the downstream includes an interval devoted to CDMA upstream signals. Low speed human interface signals such as keyboard input, mouse input etc. to interact with the central unit are direct sequence spread with a unique spreading code assigned to each remote unit. The central unit uses a bank of CDMA receivers, each of which demultiplexes the CDMA signals received from one remote unit during the CDMA interval.

U.S. patent 5,327,455 teaches a transmitter for synchronous code division multiplexed satellite communications. The manner of achieving code synchronization is not taught and is said to be conventional. There is no teachings of transmitting data in frames, and no teaching of the need for or any manner of achieving frame synchronization. The patent teaches encoding an incoming bit stream to generate multiple symbols per bit and then mapping the symbols in PSK modulator to points in a constellation with, for example, a Trellis encoder, such that inphase and quadrature bit streams are generated. Each of the separate inphaseand quadrature bit streams is separately spread with a semi-orthogonal spreading code. The resulting spread spectrum data is conventionally modulated onto two quadrature carriers which are summed and transmitted.

Specification Amendments

The amendment to specification page 143, line 26 is made to make clear that which would be apparent to one skilled in the art as inherently necessary in an upstream

training process where tap coefficients of a central transceiver modem are trained and later sent down to the RU transmitter to be used there to calculate new RU precoder filter tap coefficients so as to predistort the transmitted signal so that it will arrive already equalized. Since step 1126 of Figure 53B teaches setting the coefficients of the central transceiver modem symbol equalizer circuit to one after transferring the converged coefficients to the remote transceiver transmitter, one skilled in the art would understand that the central transceiver modem is not equalizing, so the remote transceiver must be doing the equalizing for its particular signal path for that is the reason for the transfer of the converged coefficients back down to the RU. Therefore, it would be necessary during the convergence process for the RU transmitter to not predistort the equalization training data in some embodiments, and one skilled in the art would understand this. Obviously, after the transfer of the SE converged coefficients from the CU SE circuit to the RU precode filter, the RU precode filter is doing the equalization for this RU, and it is necessary to set the CU SE filter coefficients to values which render it transparent so as to not goof up the equalization being performed by the RU precode filter. Further, the software appendices of the parent case, U.S. patent application entitled "APPARATUS AND METHOD FOR SCDMA DIGITAL DATA TRANSMISSION USING ORTHOGONAL CODES AND A HEAD END MODEM WITH NO TRACKING LOOPS", serial number 08/895,612, filed 7/16/97, define a system with remote transceiver and central transceiver modems that act in this way. This amendment should not raise new matter issues, but if the Examiner disagrees, the courtesy of a telephone call to the undersigned is respectfully requested.

The same comments apply to the amendment to page 144, line 17 with the additional comment that one skilled in the art of equalization in distributed digital data

transmission systems would realize that it was an error to say that all the taps of the FFE and DFE equalization filters are set to one after convergence and transfer of the converged tap coefficients to the RU since this is an obvious error. One skilled in the art would realize that only the main tap of the FFE is set to one and the side taps of the FFE and DFE are set to zero to receieve payload data.

The amendment at page 144, line 8 conforms the description of step 1124 in the upstream equalization process embodiment of Figure 53B for the CDMA specific transmitters disclosed herein to step 1514 of the process of Figure 60 which is an equalization process which is useful in any distributed digital data system with multiple transmitters transmitting to a singe central transceiver transmitter over different paths regardless of the type of multiplexing in use. Those skilled in the equalization art would realize that the original description of step 1124 was erroneous in not mentioning convolving the old coefficients with the new coefficients. Further, the software appendices of the parent case, U.S. patent application entitled "APPARATUS AND METHOD FOR SCDMA DIGITAL DATA TRANSMISSION USING ORTHOGONAL CODES AND A HEAD END MODEM WITH NO TRACKING LOOPS", serial number 08/895,612, filed 7/16/97, define a system with remote transceiver and central transceiver modems that act in this way. This amendment should not raise new matter issues, but if the Examiner disagrees, the courtesy of a telephone call to the undersigned is respectfully requested.

The change to page 145, lines 10-13 is made to correct an error that persons skilled in the art of equalization would have readily understood was made in the description of how the new CE equalization circuit coefficients are calculated after convergence of the SE coefficients. Persons skilled in the art would appreciate that the new RU receiver SE coefficients cannot be loaded directly into the RU CE equalizer

circuit but must, instead, be convolved with the old CE circuit coefficients to generate the new CE coefficients. Further, this amendment conforms the description of the process of Figure 53C to the process described in Figure 60 and the accompanying text. Further, the software appendices of the parent case, U.S. patent application entitled "APPARATUS AND METHOD FOR SCDMA DIGITAL DATA TRANSMISSION USING ORTHOGONAL CODES AND A HEAD END MODEM WITH NO TRACKING LOOPS", serial number 08/895,612, filed 7/16/97, define a system with remote transceiver and central transceiver modems that act in this way. This amendment should not raise new matter issues, but if the Examiner disagrees, the courtesy of a telephone call to the undersigned is respectfully requested.

The same comments made regarding the change to page 143, line 26 apply to the change made to page 170, line 14 since a person skilled in the art would realize that after the CU SE filter coefficients have converged and its coefficients have been sent to the RU to generate new precode filter coefficients there by convolving with the old coefficients of the precode filter, it is necessary to set the SE coefficients in the CU receiver to values such that the CU SE does not screw up the equalization now being performed by the RU precode filter. Those skilled in this art know that those tap coefficients are one for the SE FFE main tap and zero for the SE FFE and DFE side taps. No new matter is believed to be raised by this amendment.

The changes to pages 169 and 170 simply correct duplicate reference numbers which refer to different process steps.

The change to page 170, line 14 simply corrects an error which would have been detected by persons skilled in the art of equalization. After the coefficients of the SE circuit have converged and have been convolved with the old CE coefficients to derive new

CE coefficients, the SE coefficients must be set to main tap = 1 and side taps = 0 since to not do so would result in the equalization being done in the RU precode filter in the case of upstream transmissions or the RU CE circuit in the case of downstream transmissions being screwed up by the SE circuit in the RU. Persons skilled in the art appreciate that after the new precode or CE coefficients have been set, the SE coefficients need to be set to a transparent state of main tap = 1 and side taps = 0 so that the SE circuit is transparent (and can start to reconverge on subsequent iterations or periodic updates of the precode or CE coefficients).

Respectfully submitted,

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